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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/665,982	09/18/2003	Henry F. Erk	MEMC 02-0051 (3032.1)	5374

321 7590 11/16/2005

SENNIGER POWERS
ONE METROPOLITAN SQUARE
16TH FLOOR
ST LOUIS, MO 63102

EXAMINER	
CHEN, ERIC BRICE	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 11/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/665,982	ERK ET AL.	
	Examiner	Art Unit	
	Eric B. Chen	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 September 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-99* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *33-81* is/are allowed.

6)☒ Claim(s) *1-6,17-21,23-32,82-87,89 and 91-99* is/are rejected.

7)☒ Claim(s) *7-16,22,88 and 90* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *1/21/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of Invention I, claims 1-99, in the reply filed on Sept. 27, 2005 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> **A person shall be entitled to a patent unless –**
>
> **(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.**

3. Claims 1-6, 17-21, and 26-28 are rejected under 35 U.S.C. 102(b) as being anticipated by Ionue et al. (U.S. Patent Appl. Pub. No. 2001/0003672).

4. As to claim 1, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer (paragraph 0015), the process comprising contacting the surface of the silicon wafer with a caustic etchant (paragraphs 0069-0075) in the form of an aqueous solution comprising water and a source of hydroxide ions (paragraphs 0015, 0023), the concentration of water in the caustic etchant being less than 45% by weight (paragraphs 0015, 0030, 0049). Ionue discloses a polishing composition with water, abrasive and an alkali metal hydroxide (paragraph 0015). The concentration of

abrasive is up to 50% by weight (paragraph 049). The concentration of alkali metal hydroxide is up to 30% by weight (paragraph 030). Therefore, concentration of water can be as low as 20% by weight, or a concentration of water being less than 45% by weight.

5. As to claim 2, Ionue discloses that the concentration of water in the caustic etchant is at least about 10% by weight (paragraphs 0015, 0030, 0049).

6. As to claim 3, Ionue discloses that the concentration of water in the caustic etchant is at least about 20% by weight (paragraphs 0015, 0030, 0049).

7. As to claim 4, Ionue discloses that the concentration of water in the caustic etchant is at least about 25% by weight (paragraphs 0015, 0030, 0049).

8. As to claim 5, Ionue discloses that the concentration of water in the caustic etchant is from about 30% to about 42% by weight (paragraphs 0015, 0030, 0049).

9. As to claim 6, Ionue discloses that the concentration of water in the caustic etchant is from about 30% to about 37% by weight (paragraphs 0015, 0030, 0049).

10. As to claim 16, Ionue discloses that the source of hydroxide ions comprises an alkali metal hydroxide selected from the group consisting of sodium hydroxide and potassium hydroxide (paragraph 0023).

11. As to claim 17, Ionue discloses that the caustic etchant further comprises a salt additive (paragraphs 0015, 0024).

12. As to claim 18, Ionue discloses that the salt additive is selected from the group consisting of inorganic alkali and alkaline earth metal salts and mixtures thereof (paragraphs 0015, 0024).

13. As to claim 19, Ionue discloses that the salt additive comprises a compound selected from the group consisting of potassium fluoride and potassium carbonate (paragraph 0024).

14. As to claim 20, Ionue discloses that the concentration of the salt additive in the caustic etchant is no more than about 25% by weight (paragraph 0030).

15. As to claim 21, Ionue discloses that the concentration of the salt additive in the caustic etchant is from about 5% to about 25% by weight (paragraph 0030).

16. As to claim 26, Ionue does not expressly disclose that the surface of the wafer is contacted with the caustic etchant by immersing the wafer in the caustic etchant. However, Ionue discloses a chemical mechanical polishing of the wafers with the caustic etchant (paragraphs 0067-0075). Thus, the surface of the wafer is inherently contacted with the caustic etchant by immersing the wafer in the caustic etchant during chemical mechanical polishing. *See* Wolf, *Silicon Processing for the VLSI Era*, Vol. 4, Lattice Press (2002) ("Wolf IV"), pages 322-324.

17. As to claim 27, Ionue discloses that the wafer is rotated while immersed in the caustic etchant (paragraph 0071).

18. As to claim 28, Ionue discloses that the rate of rotation of the wafer immersed in the caustic etchant is from about 1 revolution per minute to about 100 revolutions per minute (paragraph 0071).

Claim Rejections - 35 USC § 103

19. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> **(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.**

20. Claims 23-25 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue, in view of Netsu (U.S. Patent No. 6,099,748).

21. As to claim 23, Ionue does not expressly disclose that the temperature of the caustic etchant contacted with the silicon wafer is at least about 70°C. However, Netsu discloses a method of etching a silicon wafer, including using a temperature of the caustic etchant (column 2, line 40) contacted with the silicon wafer that is at least about 70°C (column 2, lines 48-49). Netsu further teaches that etching with the caustic etchant at a temperature range of 65°C to 85°C results in an appropriate etching rate. Moreover, too low of an etching rate impairs productivity, whereas too high of an etching rate results in adverse surface effects (column 2, lines 50-54).

22. As to claim 24, Netsu discloses that the temperature of the caustic etchant contacted with the silicon wafer is from about 65°C to 85°C (column 2, lines 48-49). It should be noted that there is overlap between the Applicants' claimed temperature range and Netsu's temperature range. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a temperature of the caustic etchant contacted with the silicon wafer from about 70°C to 120°C. One who is

skilled in the art would be motivated to use a temperature range that overlaps with a temperature range known to produce desirable silicon etching rates.

23. As to claim 25, Netsu discloses that the temperature of the caustic etchant contacted with the silicon wafer is from about 75°C to 85°C (column 2, lines 48-49).

24. As to claim 29, Ionue does not expressly disclose that the wafer is immersed in the caustic etchant for a time such that the amount of silicon removed from the surface of the wafer is from about 10 μm to about 30 μm in terms of total thickness from both the front and back surface of the wafer. However, Netsu discloses a method of etching a silicon wafer, including immersing the wafer in the caustic etchant (column 2, line 40) for a time such that the amount of silicon removed from the surface of the wafer is from about 10 μm to about 30 μm in terms of total thickness from both the front and back surface of the wafer (column 2, lines 59-62). Moreover, Netsu teaches that removal of a thickness in this range is required to eliminate mechanical damage (column 2, lines 63-67) introduce by mechanically slicing the wafer (column 1, lines 15-25). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to immerse the wafer in the caustic etchant for a time such that the amount of silicon removed from the surface of the wafer is from about 10 μm to about 30 μm in terms of total thickness from both the front and back surface of the wafer. One who is skilled in the art would be motivated to eliminate mechanical damage from the wafer.

Claim Rejections - 35 USC § 103

25. Claims 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue, in view of Tsung-Kuei et al. (U.S. Patent No. 6,793,836).

26. As to claim 30, Ionue does not expressly disclose that the surface of the wafer is contacted with the caustic etchant by spraying the surface of the wafer with the caustic etchant. However, Tsung-Kuei discloses a method of wet etching, including spraying the surface of the wafer with etchant (column 1, lines 47-55; column 2, lines 55-57; Figure 1). Tsung-Kuei teaches that spray and spin etching is a commonly used wet etching technique for silicon (column 1, lines 13-18) that provides for more uniform etching (column 1, lines 35-36). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to contact the surface of the wafer with the caustic etchant by spraying the surface of the wafer with the caustic etchant. One who is skilled in the art would be motivated to use a commonly used wet etching technique for silicon that provides for more uniform etching.

27. As to claim 31, Tsung-Kuei discloses that the wafer is rotated while the surface of the wafer is sprayed with the etchant (column 1, lines 47-55).

28. As to claim 32, Tsung-Kuei discloses that the rate of rotation of the wafer is from about 50 revolutions per minute to about 650 revolutions per minute (column 2, lines 9-16).

Claim Rejections - 35 USC § 103

29. Claims 82-87, 89, and 91-99 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue.

30. As to claim 82, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer (paragraph 0015), the process comprising contacting the surface of the silicon wafer with a caustic etchant (paragraphs 0069-0075) in the form of an aqueous solution comprising water, hydroxide ions, and a salt additive (paragraphs 0015, 0024), the salt additive comprising a compound selected from the group consisting of inorganic alkali and alkaline earth metal salts and mixtures thereof (paragraph 0024), the concentration of the salt additive in the caustic etchant being at least about 4 mole percent (paragraphs 0023, 0024, 0029, 0030). Ionue discloses a concentration of the salt additive (potassium carbonate (paragraph 0024)) and hydroxide ions (sodium hydroxide (paragraph 0023)) in the caustic etchant being at most 50% by weight (paragraph 0029) with a preference of 30% by weight (paragraph 0030). A mixture of about 50% by weight water (molar mass = 18 g/mole), about 30% by weight sodium hydroxide (molar mass = 40 g/mole), and about 20% by weight potassium carbonate (molar mass = 138 g/mole) yields a water concentration of about 75 mole percent, a sodium hydroxide concentration of about 20 mole percent, and a potassium carbonate concentration of about 5 mole percent.

31. Ionue does not expressly disclose that the salt additive does not decompose or react in the caustic etchant. However, because Applicant's caustic etchant contains the same components as Ionue's etchant (paragraphs 0015, 0023, 0024), one who is

skilled in the art would expect the salt additive does not decompose or react in the caustic etchant.

32. As to claim 83, Ionue discloses that the concentration of the salt additive in the caustic etchant is at least about 5 mole percent (paragraphs 0023, 0024, 0029, 0030). A mixture of 50% by weight water, a small amount of sodium hydroxide, and about 50% by weight potassium carbonate yields a potassium carbonate concentration of about 11 mole percent.

33. As to claim 84, Ionue discloses that the concentration of the salt additive in the caustic etchant is at least about 10 mole percent (paragraphs 0024, 0029).

34. As to claim 85, Ionue discloses that the concentration of the salt additive in the caustic etchant is from about 4 to about 15 mole percent (paragraphs 0024, 0029).

35. As to claim 86, Ionue discloses that the salt additive comprises an inorganic sodium or potassium salt (paragraph 0024).

36. As to claim 87, Ionue discloses that the salt additive comprises an inorganic salt selected from the group consisting of potassium carbonate (paragraph 0024), potassium phosphate, potassium fluoride, potassium iodide, potassium chloride, potassium pyrophosphate, potassium subphosphate, potassium hypophosphate, potassium orthophosphite, potassium nitrate, potassium nitrite, potassium peroxycarbonate, potassium chlorate, potassium acetate, potassium citrate, potassium borate, potassium fluoroborate, potassium sulfate, potassium propionate, potassium selenate, potassium stannate, potassium tartrate, potassium thioantimonate, potassium thiocyanate, potassium thiosulfate, potassium tungstate, sodium carbonate (paragraph

0024), sodium phosphate, sodium fluoride, sodium iodide, sodium chloride, sodium pyrophosphate, sodium subphosphate, sodium hypophosphate, sodium orthophosphite, sodium nitrate, sodium nitrite, sodium peroxycarbonate, sodium chlorate, sodium acetate, sodium citrate, sodium borate, sodium fluoroborate, sodium sulfate, sodium sulfide, sodium propionate, sodium selenate, sodium stannate, sodium tartrate, sodium thioantimonate, sodium thiocyanate, sodium thiosulfate, sodium tungstate, and mixtures thereof.

37. As to claim 89, Ionue discloses that the salt additive comprises potassium carbonate (paragraph 0024).

38. As to claim 91, Ionue discloses that the concentration of hydroxide ions in the caustic etchant is no more than about 20 mole percent (paragraphs 0023, 0024, 0029, 0030).

39. As to claim 92, Ionue discloses that the concentration of hydroxide ions in the caustic etchant is no more than about 15 mole percent (paragraphs 0023, 0024, 0029, 0030). The amount of hydroxide in the etchant may be varied to as low as 0.001% by weight (paragraph 0030) to yield a composition no more than about 15 mole percent.

40. As to claim 93, Ionue discloses that the concentration of hydroxide ions in the caustic etchant from about 10 mole percent to about 15 mole percent (paragraphs 0023, 0024, 0029, 0030). The amount of hydroxide in the etchant may be varied to as low as 0.001% by weight (paragraph 0030) to yield a composition from about 10 mole percent to about 15 mole percent.

41. As to claim 94, Ionue discloses that concentration of water in the caustic etchant is no more than about 85 mole percent (paragraphs 0023, 0024, 0029, 0030).

42. As to claim 95, Ionue discloses that concentration of water in the caustic etchant is from about 70 to about 85 mole percent (paragraphs 0023, 0024, 0029, 0030).

43. As to claim 96, Ionue discloses that concentration of water in the caustic etchant is from about 75 to about 85 mole percent (paragraphs 0023, 0024, 0029, 0030).

44. As to claim 97, Ionue does not expressly disclose that the pH of the caustic etchant is at least about 13. However, the pH of sodium hydroxide solutions is inherently greater than 12. *See* ClearTech Technical Department, ClearTech Industries, Sodium Hydroxide Solutions MSDS (2001).

45. As to claim 98, Ionue does not expressly disclose that the pH of the caustic etchant is from about 13.9 to about 14. However, the pH of sodium hydroxide solutions is inherently greater than 12. *See* ClearTech Technical Department, ClearTech Industries, Sodium Hydroxide Solutions MSDS (2001).

46. As to claim 99, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer (paragraph 0015), the process comprising contacting the surface of the silicon wafer with a caustic etchant (paragraphs 0069-0075) in the form of an aqueous solution comprising water, hydroxide ions, and a salt additive (paragraphs 0015, 0024), the salt additive comprising a compound selected from the group consisting of potassium carbonate and potassium fluoride (paragraph 0024), the concentration of the salt additive in the caustic etchant being at least about 1 mole percent (paragraphs 0023, 0024, 0029, 0030). Ionue discloses a concentration of the

salt additive (potassium carbonate (paragraph 0024)) and hydroxide ions (sodium hydroxide (paragraph 0023)) in the caustic etchant being at most 50% by weight (paragraph 0029) with a preference of 30% by weight (paragraph 0030). A mixture of about 50% by weight water (molar mass = 18 g/mole), about 30% by weight sodium hydroxide (molar mass = 40 g/mole), and about 20% by weight potassium carbonate (molar mass = 138 g/mole) yields a water concentration of about 75 mole percent, a sodium hydroxide concentration of about 20 mole percent, and a potassium carbonate concentration of about 5 mole percent.

47. Ionue does not expressly disclose that the salt additive does not decompose or react in the caustic etchant. However, because Applicant's caustic etchant contains the same components as Ionue's etchant (paragraphs 0015, 0023, 0024), one who is skilled in the art would expect the salt additive does not decompose or react in the caustic etchant.

Allowable Subject Matter

48. Claims 7-16, 22, 88, and 90 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

49. The following is a statement of reasons for the indication of allowable subject matter for claims 7 and 22: there is no motivation or suggestion for the concentration of the source of hydroxide ions in the caustic etchant greater than 55% by weight. The closest prior art, Ionue, discloses a concentration of the source of hydroxide ions in the

caustic etchant of 50% by weight (paragraph 0029). Moreover, Netsu et al. (U.S. Patent No. 6,099,748) teaches away from a silicon wafer etchant with a source of hydroxide ions (sodium hydroxide or potassium hydroxide) (column 4, lines 34-39) greater than 55% by weight, because this higher concentration results in the precipitation of the alkali component from the etching bath (column 4, lines 15-21). Thus, there is no suggestion or motivation for the concentration of the source of hydroxide ions in the caustic etchant greater than 55% by weight, as in the context of claim 7.

50. The following is a statement of reasons for the indication of allowable subject matter for claim 88: there is no motivation or suggestion that the salt additive comprises potassium fluoride. The closest prior art, Ionue, discloses the salt additive comprises potassium carbonate (paragraphs 0015, 0024). However, there is no motivation of suggestion of the salt additive comprises potassium fluoride, as in the context of claim 88.

51. The following is a statement of reasons for the indication of allowable subject matter for claim 90: there is no motivation or suggestion that the salt additive comprises an inorganic alkali metal or alkaline earth metal salt hydrate. The closest prior art, Ionue, discloses the salt additive comprises potassium carbonate (paragraphs 0015, 0024). However, there is no motivation of suggestion that the salt additive comprises an inorganic alkali metal or alkaline earth metal salt hydrate, as in the context of claim 90.

52. Claims 33-81 are allowed.

53. The following is an examiner's statement of reasons for allowance for claim 33: there is no motivation or suggestion for the concentration of the source of hydroxide ions in the caustic etchant greater than 55% by weight, as discussed above.

54. The following is an examiner's statement of reasons for allowance for claim 63: there is no motivation or suggestion for an aqueous solution comprising water and a source of hydroxide ions, the concentration of the source of hydroxide ions in the caustic etchant being at least about 70% of the saturation concentration of the source of hydroxide ions in the caustic etchant. Using a solubility value of 111g of NaOH in 100g of water at 20°C (or the saturation concentration), 70% of the saturation concentration would be 77.7g NaOH or 77.7% NaOH by weight. A similar calculation can be performed using a solubility value of 119g of KOH in 100g of water at 20°C (83.3 % KOH by weight). As discussed above, there is no motivation or suggestion for the concentration of the source of hydroxide ions in the caustic etchant greater than 55% by weight.

55. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-

2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

EBC EBC
Nov. 4, 2005

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER